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Physical Geography

LECTURES

Delivered in 1865 by

Prof J. C. Draper

NEW YORK

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PHYSICAL MAP OF THE WORLD

FIRST
LECTURE.

PHYSICAL GEOGRAPHY

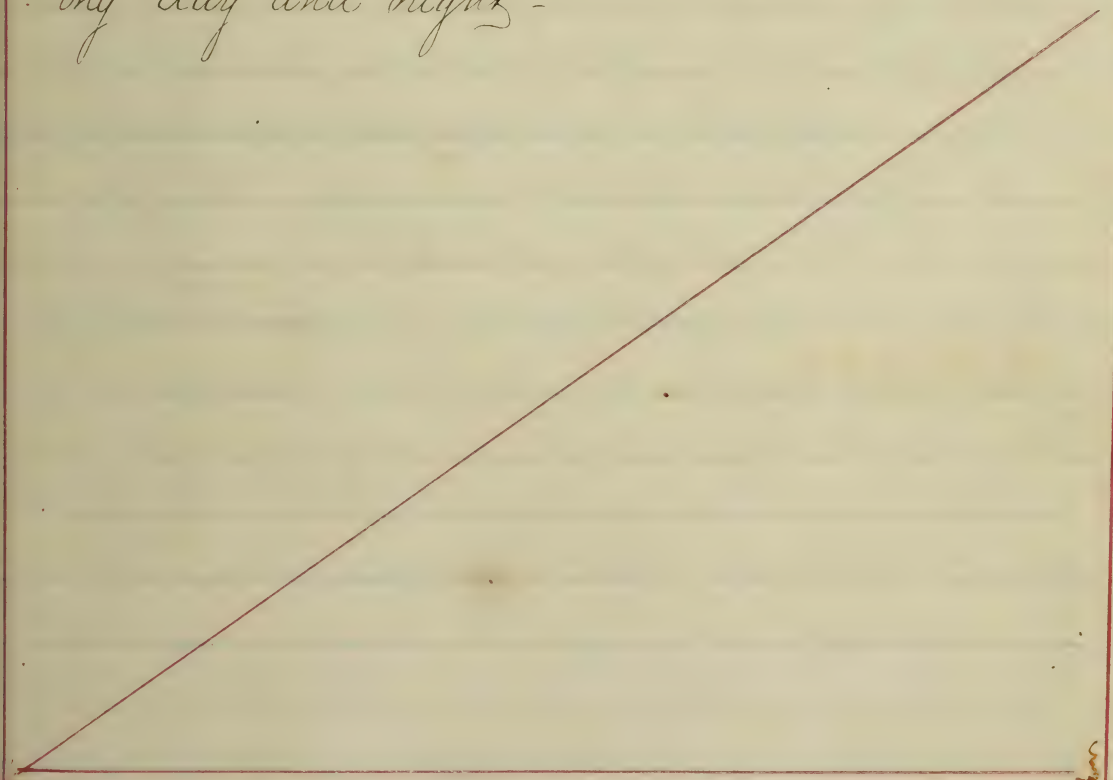
The old idea of Geography was, that it should deal altogether with the situation of rivers, towns &c: it was truly a mere superficial anatomy of the skin of the Earth. Physical Geography which has come into existence during the last century deals also with the forms of relief, of sections of various portions of the Earths surface and with the contour of coast lines, examining also their influence on the distribution of plants and animals. Guyot describes it as "the science of the grand phenomena of the present life of the globe, their connection and mutual dependence."

Physical Geography is to be studied by the following divisions:

1st The Earth.
2nd Form and Contour of the Lands.
3rd " " " Ocean.
4th The Current of the Ocean.
5th " " " Air.
7th The Earth treated as an individual illustrating the great law of life.
8th The Three Great Contrasts.
9th The Effects of the Contrasts on Plants & Animals
10th " " " " " Man.

EARTH. The old idea of the Earth was that it was the greatest body in existence and the centre of rotation of planets, that the dry lands were surrounded by an ocean and that the surface of the land was a plain. 600 B.C. Thales was born. He taught the sphericity of the Earth and explained eclipses

This theory was succeeded 1400 years afterwards in the year 800 A. D. by the Geography of Cosmos Indicopleustes, which taught that the Earth was a plain, surrounded by an ocean, furnished with a mountain behind which the sun went at night, thus causing day and night -



The modern idea of the

Earth " similarity of matter "

Note 1 Certain substances when brought in contact with a colorless flame no color will result- but coat this substance with soda and an exceedingly yellowish flame will result. now if the rays of the sun are passed through this rays a black surface will appear on the Spectrum " thus demonstrating the cause of the yellow rays of the sun

Modern Idea of the Earth

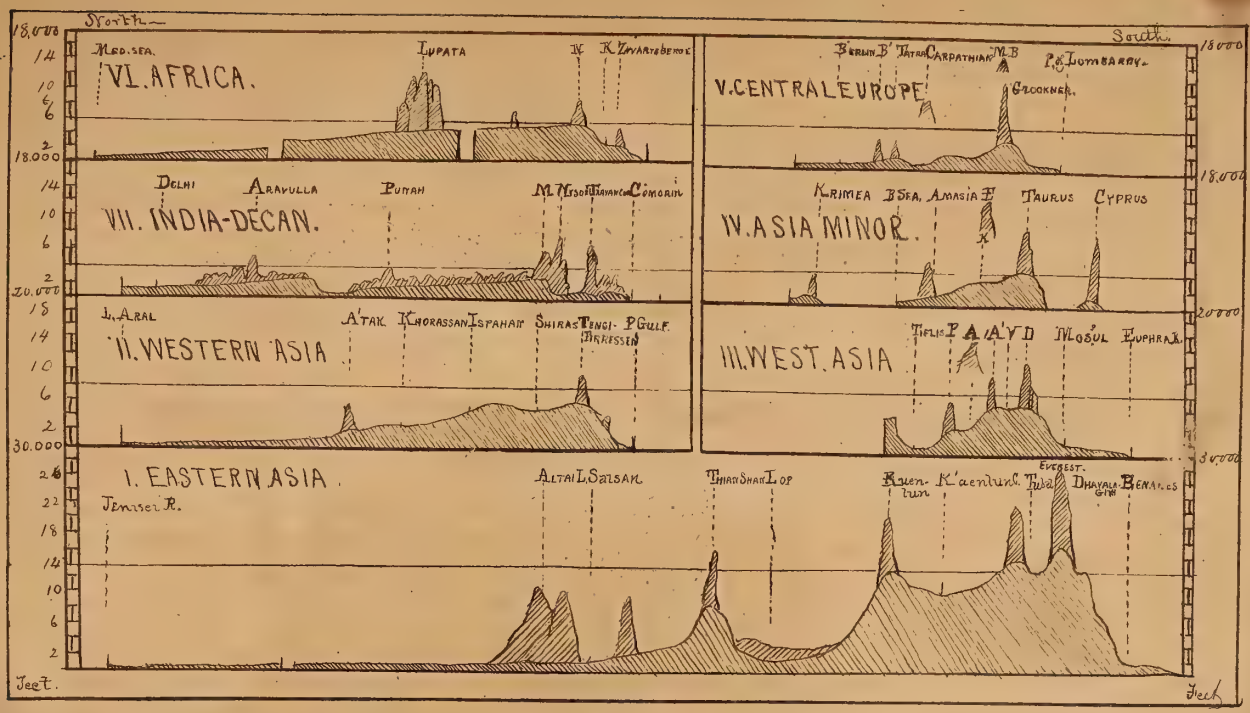
The modern idea of the Earth is that instead of it being the largest body in nature, it is in reality only 1/1,000,000 of the size of the sun and that the sun is the centre of our Solar System. The nearest star is 7000 times as far off from the sun as Neptune the distance of which planet from the Sun is Three thousand Millions of miles.

The Earth like other cosmic bodies obeys the laws of gravity; It is similar in composition to other cosmic matter as is shown by the meteors which fall on its surface from regions exterior to its surface and atmosphere. By examining the light emitted by other planets and stars, we find that they contain substances similar in composition to those which fall on the Earth. see note 1

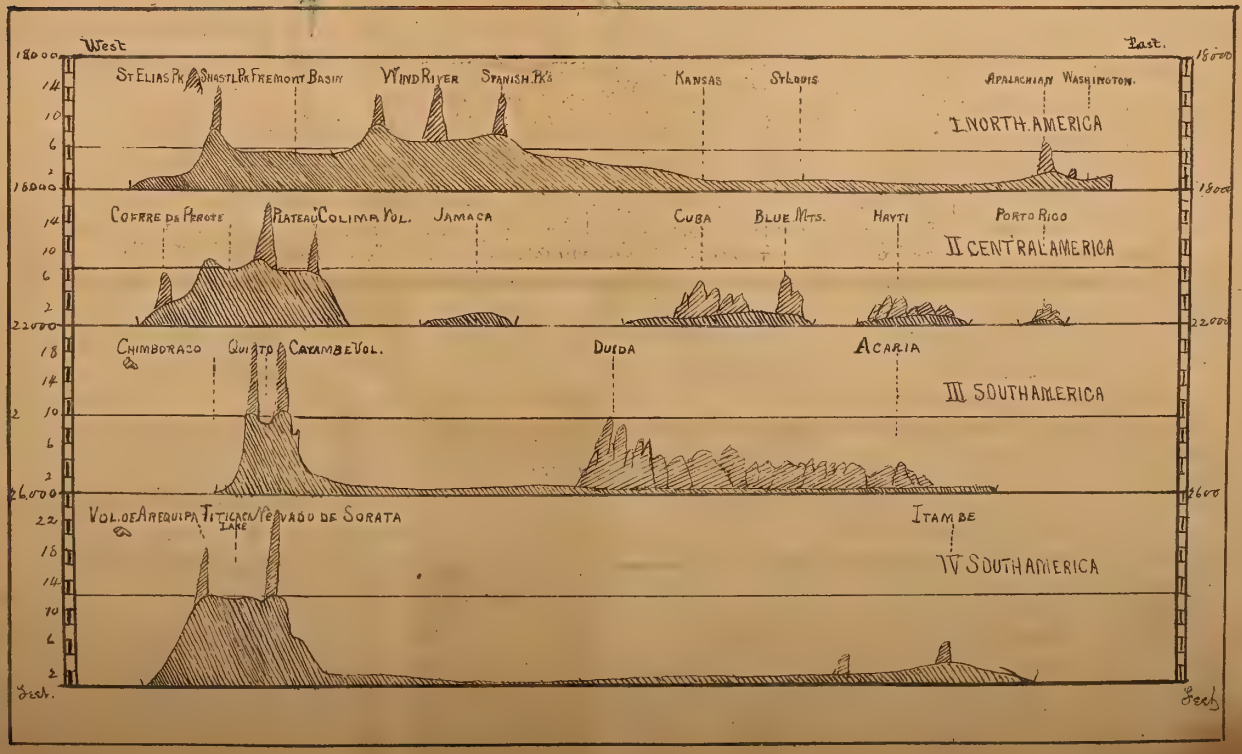
In the case of mars, at certain seasons of the year, the light reflected from the northern pole of the planet is intensely white over a considerable space, while that reflected from the opposite is but small in amount; a little later on the first pole reflects the smallest amount of light and the second the greatest amount; this is owing to the fact that the surface of the planet is covered with water which forms ice and snow at one or the other pole according as it is nearest to the sun. In case of the moon, its surface is composed of vast extinct volcanoes into the craters of which we can look down and find them composed of angular blocks of stone; water is not present but the different light and shade of various portions is due to the character of reflective solids; some portions doubtless being limestone reflecting a white light, while others are

granite or trap giving the shaded portions because they reflect less light. Another Evidence that cosmic matter throughout the universe is the same, is evidenced by the fact that the laws for heat, light and electricity are the same throughout space.

The shape of the Earth is a flattened spheroid, the Equatorial radius being 3963 miles, while the polar radius is 3,950 which is the figure that a fluid mass of the size and density of the Earth would assume if subjected to an equal velocity of rotation. From this fact we are forced to conclude that during the earlier part of the Earths existence, it was a fluid mass, that gradually as condensation took place the land, crusting over an interior mobile mass, was formed towards the center of the globe; gradually the temperature of the sur-



VERTICAL PROJECTIONS.



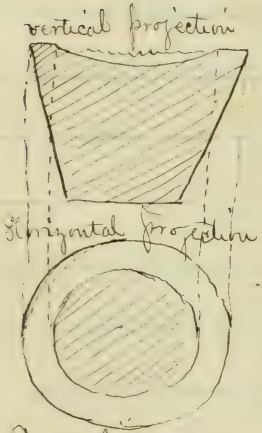
face fell, the waters condensed & a boundless shoreless ocean was formed, Exterior to which air was placed, and this steadily decreased in density from the surface of the sea to its external limits."

Forms & Contours of the Lands.

The proportion of land to water which is exposed to the action of the air is about three of land to eight of water: but in the Northern Hemisphere there is about three times as much lands as in the Southern. Examining we find the North Temperate zone is one half land, the Torid one third land, while the South Temperate is only one tenth land. Ritter noticed that if the poles of the land hemisphere which is in the British channel is placed in the Zenith, the horizontal circle

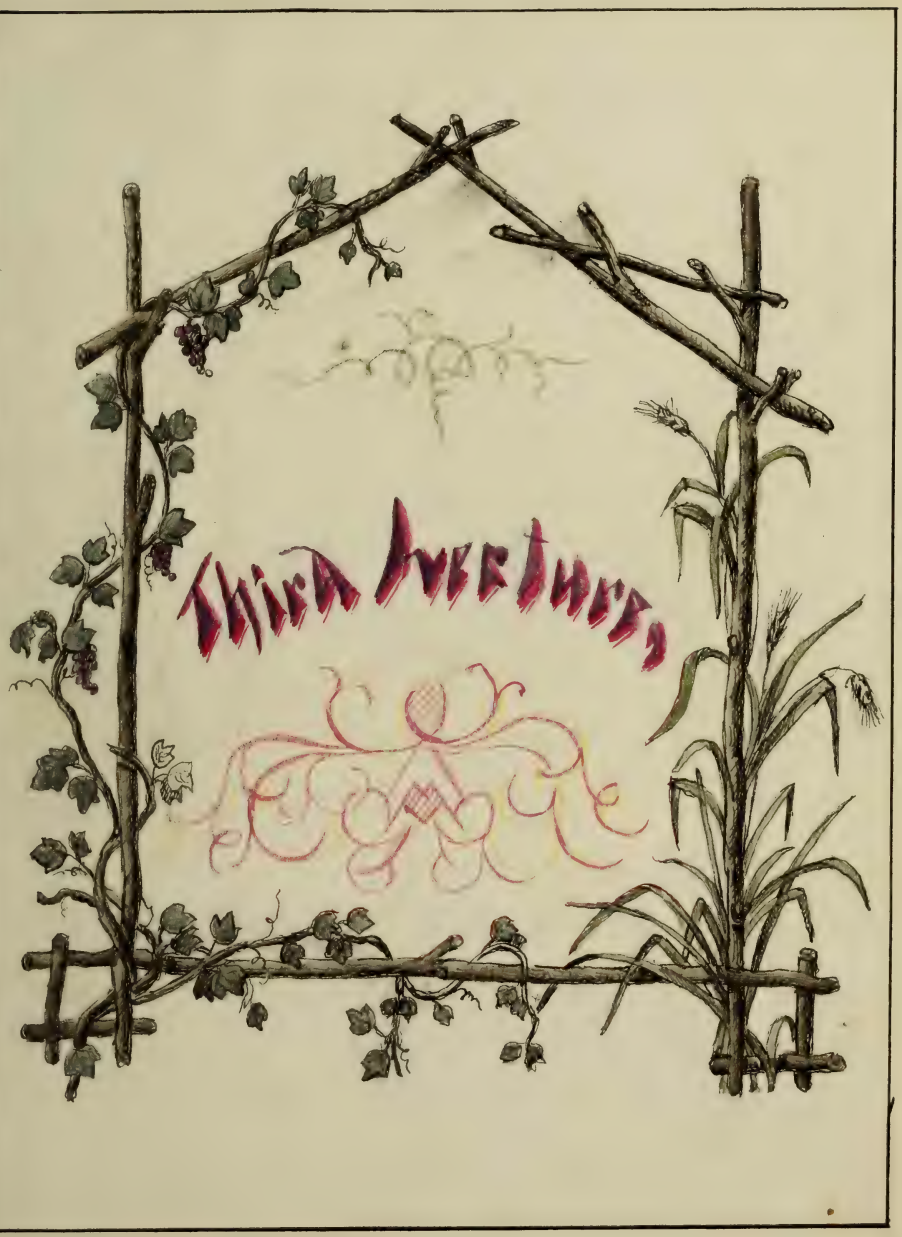
of the globe divides its surface into a land and water hemisphere. "The surface of the Earth with the exception of the isthmus of Darien & of Suez is completely divided by the Atlantic Pacific & Indian Oceans and Red and Mediterranean Seas. Humboldt was first to notice the parallelism of the shores of the Atlantic Ocean. the projection of one shore being opposite to the reentering angles of the other. Lord Bacon was first to draw attention to the fact that the Eastern and Western worlds both terminate towards the south in a rugged, rocky point, the western coast of which is steep- while to the East of the point is an island or collection of islands, showing the past existence of some mighty movement of the waters which washed the western coast."

Note 2 – Construction of the Coral Islands –



Coral Islands.

The pollyps begin at the bottom and as they approach the surface of the water they are reinforced by new constructions and thus – they form a sort of truncated cone – as shown in figure – these islands often are hollow & the interior is filled with water sometimes fresh & sometimes salt„


THIRD YEAR

On the western side of the continent there is a deep bend towards the interior (showing a uniformity of action).

The islands connected with the different Continents partakes of their character, while those at a distance from the main land are generally possessed of peculiarities of their own and usually the tops of lofty mountains. The great majority of oceanic islands are to be found in the Pacific Ocean and as a rule the seem to be arranged in a line, which follows an East by South East Course.

Islands sometimes arise by animal action as it were. The coral islands are being formed by a water insect called pollyps. see note 2. for Const. &c — The great map of the land is contained in the continents six in number. They are grouped 1st as Old World and New World, the direction of the greatest length in this group being inverse. 2nd They may be grouped into three double worlds — first

North and South American 2nd Europe and Africa and 3rd Asia and Australia. The continents of each world are united by an isthmus, with an archipelago on one side and a peninsula on the other In the Europe Africa World. Italy and Sicily form the peninsula - and Spain becomes the peninsula while the Islands of the adriatic forms the archipelago; in the Asia Australia World. Bornes & Java form the isthmus, India the peninsula and the East Indies the Archipelago. In the American World The divisions are equal, In the Europe, Africa, the second is the largest and in the Asia Africa world - the first. The continents may be studied 1st in relation to their coast line or horizontal arrangements. 2nd in relation to their relief or perpendicular arrangement -

TABLE OF HORIZONTAL CONTOURS OF THE COAST

Continents	Surface in Sq. Miles	Coast Line	Proport. of Land to Coast
Europe	2.688.000	17.200	156
Asia	14.128.000	30.800	459
Africa	8.720.000	14.000	623
N. America	5.472.000	24.000	228
S. America	5.136.000	13.600	376
Australia	2.208.000	7.600	290

Vertical Contours

In Studying the vertical contours there are many difficulties; The chief are, 1st, only the contours of certain localities are known; 2nd they are not represented on ordinary maps; third necessity which exists for exagerating the profile in order to make evident variations

in the vertical contour. The effect of the variation in the height above the level of the sea is shown by the fact that if we rise 350 feet above the sea level the average annual temperature fall one degree, in order to obtain the same fall of temperature at the leve of the sea it is necessary to move northward 60 miles. A movement of 350 feet in a vertical direction is equal to a horizontal movement of 60 miles as regards temperature.

Vertical elevations are spoken of 1st as plains or lowlands and are usually less than 1000 feet and frequently, as in the case of the valley of the Mississippi, less than 100 feet above the level of the sea, 2nd Plateaus which are usually from 1000 to 5000 feet above the level of the sea and sometimes more

as in the case of the plateaus of the Himmelaya Mountains, They are usually great elevated plains, and 3rd Line elevations as in mountain ranges. The study of vertical elevations was first directed altogether to the linear elevation, Since they produce most marked effects not only seperating but dividing nations from each other on account of the difficulty of communicating and in many cases dividing races of Animals & plants which are unable to pass over or around them.

In the Old World the mountains ranges follow the parallels moving East & West In the New World they are the reverse, the great ranges following the meridians due North and South. In the Old World the secondary ranges are at right angles to the great ranges moving North & South while in the New they run E & W.

LAWS OF RELIEF

As a rule the surface of a continent rises gradually from the sea toward the interior to the line of greatest elevation. The exceptions to this rule are are, first, the Caspian Sea & Second the Valley of the Dead Sea & Jordan, and the bottoms of some of the Lakes among the Alps, in the Old World. (the depth of the valley of the Dead Sea below the Mediterranean as shown by the measurements of Lieut Lynch is 1300 feet.) In our own country the bottoms of the great lakes and many of the smaller lakes at the Canadian regions, are beneath the level of the sea. 2nd The line of maximum elevation in any Continent is not in the center but is at one side of the

continent forming two unequal slopes - one being four or five times as long as the other. 3rd Law of increase applies also to linia and mass elevation. These two laws (2d & 3d) apply not only to Continents but also to great peninsulas such as India and Arabia. 4th The long slope is toward the North in the Old World and towards the East in the New World. Consequently since rivers must take the course of inclination of the land they all flow in America into the Atlantic and the commerce of that nation is directed to that ocean, while the rivers of the old world would flow either directly to the Atlantic or into the Mediteranean or North seas and thence into the Atlantic, carrying the commerce of those regions into that Ocean making it the great highway."

5th Though the great slopes in the New World are directed to the East the minor slopes look to the North. the lesser slopes bearing the same proportion to the greater in both worlds as the mountain ranges &c. 6th As a rule the relief increases gradually from the poles to the equator, but the highest points are not at the equator but directly North and South of it. The highest portion in the Northern Hemisphere being in the old world at Mount Everest one of the Himmalaya range in 27° N. Lat. while the highest in the Southern Hemisphere is one of the Andes called Nevado del Sorata which is situated in 18° So. Lat. Since the long slopes are toward the Atlantic & Arctic & short slopes chiefly to the Pacific and Mediteranean sea & Indian Ocean. it is supposed by some

that the bed of these oceans have undergone a sudden depression and perhaps at no distant period were above the level of the sea. The existence of active volcanoes on the borders of the Pacific and its numerous islands have led many to support this idea.

At the same time that the beds of the ocean disappeared the mountains on their borders were elevated, so that the Himmalayas, Andes and Rocky Mountains are the most recent, and at the same time most elevated ranges.

FIFTH LECTURE.

Distribution of Lands.

Examining the Old World we find that five-sevenths of the land is composed of Platoes and Mountains, the whole of Central Asia being a platoes 2400 by 1500 miles and 6000 feet above the sea. Europe is free of platoes being composed of mountains and plains. In the New World the greater portion of the lands is plains, mountains and platoes being less than one-third: it therefore presents a greater surface for raising grain and the communication from North to South is uninterupted.

Average Elevatation of the Land above the sea.

according to La place it is 3000 feet which is probably far in excess to the true amount. Humbolt furnishes us with the following. for Europe 671 - Asia 1151 N. America 784 S. America

1132 Total mean average 1008. Comparing the Elevation with the depression of the ocean bed we find that if all the land were placed in the sea it would fill it about 1/40th The greatest Elevation is that of Mount Everest one of the Himmalaya range which is 29 000 Feet high the lowest portion is the Dead Sea and Valley of the Jordan 1300 feet below the level of the Sea

Forms and Portion of the Ocean

1st Horizontal Contour or shore line of the Atlantic is 2800 miles wide, Pacific 6000 miles America 2200 miles wide Old World 6000, there is therefore a sort of connection between the widths of oceans and the continents.

The oceans are divided into three classes 1st those which have a gulf like form

like the gulf of Bengal. 2nd a land locked sea like the sea of Japan and 3rd Inland seas like the Mediteranean. The Indian Ocean has the first form: the arms arms of this sea are also gulf like. as the Gulf of Bengal and the Arabian Gulf. The Pacific belongs to the second class and its arms are also inland seas. E.g. Behring Sea. Japan Sea. N. China Sea. S. China Sea and Okholsk Sea. The Atlantic assumes the third form. being an inland sea and its arms are also land locked. They are ~~also~~ four in number. Mediteranean Baltic Gulf of Mexico and Hudsons Bay. Of these oceans the Pacific is most Oceanic in its character, while the Atlantic is spoken of as being the most maritime of the oceans. all the great rivers of the continents flowing into it and its shores being studded with good harbors.

Vertical Contour of the Ocean

The greatest depth of the Atlantic in the more northern portions are those furnished 1st by Lieut S. Bache in 34° N. Lat. which is 13000 feet by the line: Thermometric soundings by Lieut R. Bache off Cape Hatteras 19,800 feet: in 1849 while making soundings 31°59' North Lat. 58°43'25" West from Greenwich the line broke at 34,200 this sounding by Lieut Walsh U.S.N. but since it fall within the influence of the gulf stream the line was probably drifted and the result faulse: the depth next to this probably correct was obtained by Capt. J. C. Ross British Navy, off St. Helena 27,600 feet. Dr Young has estimated the average depth of the Atlantic at 15000 feet. Average Pacific 20,000 D'Aubuisson estimates the average Atlantic depth at 9000, Average Pacific 12000 he

is probably more correct than Young's. Prof. Deirce by calculating the intersection of slopes of Africa and South America toward the atlantic found that they met at a dist of 1000 miles from American coast which would give as the average depth of the atlantic 15000 ft. In laying telegraph from Ireland to New Foundland the soundings showed that the average depth of the true ocean basin varied from 10000 to 15000 feet.

Formation of the Sea basin close to the coast. The Baltic is about 120 Feet deep Gulf of Mexico about 600 feet and the North Sea from 300 to 600 and the Adriatic 130. near the land and in the gulfs and seas surrounded by the land, the ocean becomes shallowed and as a rule the depth may be truly calculated from the slopes of the country.

The same rule holds also for inland seas Exception being the Lago Maggiore, a small lake among the Italian Mountains and whose depth is 2200 feet; the Straits of Gibraltar are 1000 Feet deep, while the Mediteranean ~~Coast~~ of the Coast of France & Spain opposite the Sierra Nevada is 6000 feet deep and off the coast of Sardinia 5000 feet deep. Though the foregoing is a rule still there are many exceptions so off the precipitous South African Cape at a distance of 100 miles the sea is only 600 feet deep. Off Lima in the Andes, at a distance of 40 miles it is only 600 feet deep. Off the plains of the Bay of Biscay close to the shore it is over 1000 feet deep Off the Ireland Coast within a few miles of the shore the altitude is 2000 feet deep. If we study the Soundings

along the coast we find as a rule that they follow the slopes of the coast but only to a comparatively small distance from the coast: then suddenly the true ocean basin forms and soundings of many thousand feet are reached.

LAWS OF LIFE

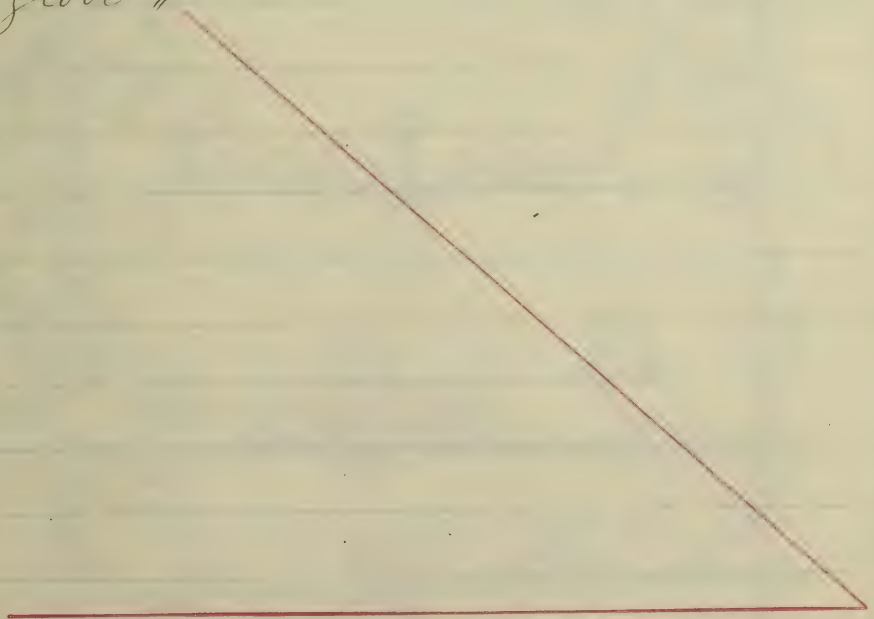
THE DEVELOPMENT

All creatures take their origin in what may be called a chaotic unit. In the case of animals this is a homogenous animal mass which we call an egg or ovum: it is not possessed for an individual animal of any characters but all ova are alike, consisting of an external envelope containing a semifluid material, but has no organism - except at one germinal point

or spot at which changes commence.
the second is the stage of diversity; at
points in the original unit there commences to appear a concentration and separation of matter, each of these gradually takes on a definite form and special organs are produced; the third stage is that of a harmonic unit in which the organs which have been formed are coordinated and react on each other, and the existence of the harmonic unit and its perfection depends upon the perfection of the parts composing it and their coordination and relation to each other, applying this to man, we have first his origin in the ovum furnished by the female in which gradually density takes place and organs are produced, these being properly co-

ordinated gives us the focus or harmonic unit which becomes perfected at the moment of birth and what was one harmonic unit coming in contact with other similar men and there, through their intellect reacting on each other advance the whole race which becomes a grand harmonic unit. As an example of the effects of these reactions, we find that where there is mere commercial exchange the prosperity of the race is increased and where there is exchange by pen and speech the intellect is developed. That where there is exchange of sentiment and affection happiness is increased; the perfect unit is to be obtained by all three systems of exchange, and the highest condition of life is reached where there is an animated interchange between the elements

of an unequal duality, the greater the variety of individualities in societies, the more elevated is the order and the greater diversity of organs in an individual the higher is the rank of life of the individual, examining into the past history of the globe we find that we can treat its as an individual & a race also aply to the globe "



Seventh Lecture.

THEORY OF LAPLACE

According to the theories of La Plas and Herschel. they both suppose that in the commencement space was occupied by a gaseous mass without form, constituting first the chaotic unit, second the development commenced and the second stage of diversity by the atoms of gas concentrating and gravitating together so that irregular spheroidal masses were produced and owing to the concentration, heat and light were evolved, and the visible nebulae appeared, each of the nebulae formed, constituted the nucleus of a distinct solar system: Third the Harmonic unit of the universe was formed by each nebulous mass, as it revolved on its axis, still underwent condensation on the exterior and as a result one planet after another

of the system was formed until finally the central mass by continued gravitation remained as a central sun to the system. Since the sun and each planet had taken its origin from the same nebulous source it followed that the movement which pertained to the nebulae also belonged to the planets which had arisen from it consequently in our own system the rotation of the sun is from East to West and each planet as it moves in its orbit follows the same course. The formation of the satelites of the planets took place in the same way as the planets themselves and has the same movement around its axis and the planet that the planet has to the sun

After the formation of the moon the concentration still continuing and the various chemical actions still uniting. the Earth assumed the form of a flattened spheroid and a gas, a liquid and ultimately a solid mass produced, these arrange themselves according to the laws of gravity. the solid earth in the interior, the liquid ocean covering it and the primative ~~ocean~~ atmosphere loaded with Carbonic Acid Gas being the Exterior Envelope, at this period there were but two elements in contact, the land everywhere was beneath the surface of the sea and the primative ocean, and air were alone in contact; it is called the oceanic Epoch. In this period, regular, uniform and languid winds

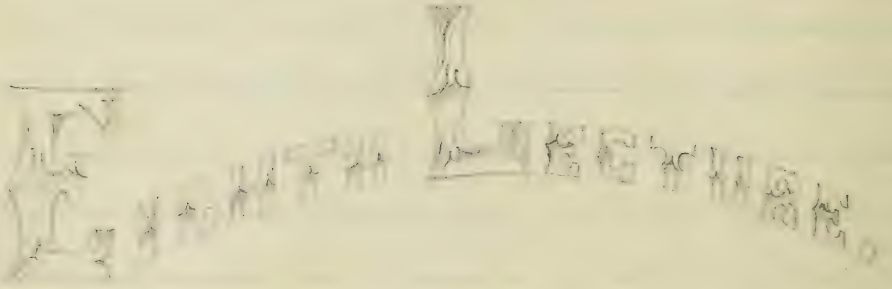
an currents in the sea existed, taking their origin in the intense action of the suns heat on the equatorial regions there was no dry land to break their action, consequently they were perfectly regular; rains existed but since there was no land to receive them they were useless and without effect. The density of the atmosphere was far lighter than at present and there was but a slight difference in the temperature of the equatorial regions and the polar; under such a condition, organic life of the lowest order can exist and plants and animals of the lowest grades originated in this period. Gradually in the shrinking and the convulsions of the surface caused by the cooling of the central solid mass.

EUROPE

INSULAR EPOCH

CONTINENTAL EPOCH

The third Element of the Earth rose up to the surface of the ocean and coming in contact with the the air and water supplied a condition favorable to a higher condition of life; to this period the name of the insular Epoch is given. The winds and currents in the sea become irregular, for since the dark earth absorbed the suns heat more perfectly than the ocean, the air covering the land became more intensely heated and currents of air were formed which contending with the winds of the ocean caused them to become irregular. At the same time the land acting as an obstruction to the original oceanic currents diverted them from their course and caused them to become



Maritime Epoch.

The sinking of the solid globe as it cooled, gradually brought more and more land in contact with the air and above the surface of the sea, new mountain ranges made their appearance and these gradually warmed down the action of the atmosphere and vast formed plains in which the gigantic firs and conifirs flourished. These gradually abstracted from the atmosphere the enormous excess of Carbonic acid and as forest after forest was leveled, the foundation of the present Coal deposits were formed. Geologists call this period the commencement of the "Tertiary Epoch" In this period a high degree of life could exist since the atmosphere had lost a portion of its carbonic acid and we find that reptiles of the lizard class made their appearance

Formation of Coal Deposits.

All over the surface of the globe we find remains of the same plants in the coal deposits showing that at this period, the temperature of the air and the climate was similar all over the globe. The forests were composed of palm trees between the trunks of which there grew enormous firs: from various causes partly natural decay forests were levelled and over them new forests grew, these in their turn being levelled enormous masses of vegitable matter accumulated in certain regions these after a while owing to the movement of the Earths crust were submerged beneath the water, the sand was drifted over them and a species of fermentation set in during

which the vegitable matter was converted into bituminous coal and the sand which covered it was solidified into a sandstone. again during some subsequent convulsion the land has risen above the sea and new forests have grown, and these again have been submerged and second deposit of coal formed on top of the first: in some portions of the Earths surface as much as twenty distinct deposits have taken place and thus furnish us with the data from which we may estimate the age of our globe since the commencement of the insular Epoch. In Nova Scotia peculiar facilities exist for the examination of the successive deposits, for after the deposits were formed over each other a mighty convulsion occurred in which they were snapped across and the

Edges brought to the surface so that as we travel over the surface of the island we can examine in a horizontal line one section of the original strata.

Anthracite Coal.

The bituminous coal differs from the anthracite in the fact that, 1st it contains an Enormous amount of Carbon and Hydrogen. & also will furnish when heated a species of oil called "petroleum": if the temperature is increased Carburetted Hydrogen gas instead of oil is given off. the anthracite on the contrary cannot on the contrary furnish either gas or oil, but it contains a large amount of carbon & no Hydrogen, it is really bituminous coal which has undergone natural distillation in the interior

of the Earth and has lost its oily or gaseous portions there as they were disengaged not being able to Escape on account of the layer of Sandstone and soil which covered them, & have become accumulated in Cavities and deposits which we now tap in the construction of oil wells; this distillation is still going on in some regions, while in others it has ceased, as is shown by the fact that some wells flow for a few months and then dry up, while others flow as freely now as in the beginning. In China Oil wells & gas deposites have been in operation for more than Twenty five hundred years and they are ahead of us in that, that some of their cities are lighted by gas secured from such natural sources.

Gradually the tertiary basins were filled up, and the islands were consolidated into continents, the salt sea water disappeared from the land, then inland salt basins drying up and forming the rock salt deposits whilst rivers, springs and Lakes derived from the rain made their appearance, the atmospheric water gradually softened down the rugged outline of the mountain ranges and formed at their base an alluviak in which higher species of plants could grow: the carbonic acid of the air being greatly diminished, the great oaks and trees of dense woods grew, the animal types were more perfect and the remains of birds and animals are found in the deposits of this period which is called the Continental Epoch

Ninth Lecture

The Three Great Contrasts.

1st Contrast of the Oceanic and Land Hemisphere.

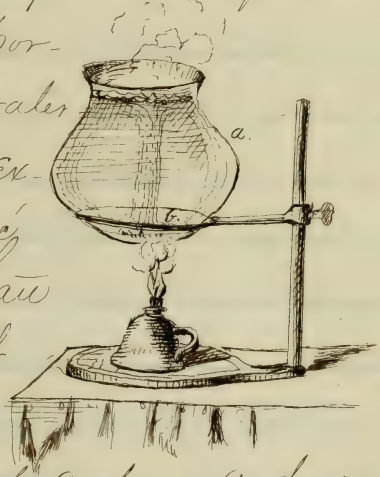
2nd " " " Old and New World

3rd " " " Three Northern & Three Southern (Hemispheres) Continents.

Examining the relative position of of the land and water we find that Ritters line or the great circle which passes over the western coast of Peru. the peninsula of Malacca and the southern point of Asia, forms a North East Hemisphere which contains Five Continents and a South Western Hemisphere or water Hemisphere in which is contained but one continent, Australia. Owing to this distribution of land the climate prevailing to the north of Ritters line is totally different from that which prevails to the South of it

The Water Hemisphere is charactarised by a greater similarity of winds and currents in all its parts; its surface though it seems to be horizontal and imparts to the mind the idea of an infinite distance is in reality a sphere and to a person standing on the deck of an ordinary vessel the horizon is limited by a circle the diameter of which varies from Twenty-five to Thirty miles; The surface though at times calm is by the action of the winds thrown into waves the heights of which measuring from the bottom of a depression to the top of the crest rarely exceeds Thirty feet; in addition to the waves there are in the ocean great river like currents which originate in the different specific gravity of warm and cold water."

To illustrate this theory - ani a vessel of water is place small portions of amber (b) on heating the lower portion of the vessel the water in that portion becomes expanded and its specific gravity becoming less than the surrounding water it rises to the top drifting in its course the pieces of amber, and as new particles of water are heated these rise to the top and the cooler portions pass along the surface down the sides and in their turn are heated and rise again - thus forming a regular current which is continued as long as the heat is applied so in the case of the water hemisphere since the sun rays act with the greatest intensity



at the Equator a similar relation exist, and there is a tendency to the formation of a currents in the ocean the course of which would be if the Earth did not rotate from the bottom of the Equatoreal ocean to the surface along the surface to the poles - and from the poles along the bottom to the Equatoreal regions: Since the earth is moving upon its axis from east to west, instead of the currents moving directly north it has imparted to it a diagonal course and the currents more North East and South West. By the action of these currents the waters in the South Oceanic Semisphere being thoroughly mixed there is a tendency to the production of an equal temperature: the air of the same regions, owing to the same cause warmed in an equible manner

and as a result there is produced a warm moist climate subject to but slight variations; In the N. Continental Hemisphere on the contrary the land since it is darker in color than the ocean, absorbs the heat of the sun more completely and the heat being radiated more easily the atmosphere in contact with the land is drier and reaches a far higher temperature than that in contact with the ocean. The fixed nature of the particles also aid in the same direction and as a result since the variations of temperature are greater where the sea and land come in contact the variations are in the temperature of the air are more excessive and the atmosphere in inland regions is far drier. as an illustration of this difference of sea and inland temperature we

will compare the temperature of the Färoe islands, situated in the midst of the Atlantic with that of St. Petersburg or Yakutsk in the depths of Siberia; these three places being situated between 60° & 62° N. Lat.

Variation of Temperature.

	Winter	Summer	Difference deg. cent.	Difference deg. Fah.	
Färoe	3.6	12.2	8.6		Cent.
	38.5	54.0	" "	15.5	Fahr.
Petersburg.	-8.7	16.0	24.7		Cent.
	16.3	60.8	" "	44.5	Fahr.
Yakutsk	-38.9	17.2	56.1		Cent.
	-38.0	63.0	" "	101.0	Fahr.

We also find as might be expected greater Extremes of temperature; we will now compare nearer the tropics.

		Winter	Summer	Difference deg. Cent.	Difference deg. Fahr.
Madeira	Cent.	16.3	21.1	4.88	
	Fahr.	61.3	70.0	" "	8.7
Bet. 30° & 32° N. Lat.		—	—	—	—
Cairo —	Cent.	14.7	29.2	14.5	
	Fahr.	58.5	84.6		26.1

As an example, in our own Country:

		Winter.	Summer	Difference deg. Cent.	Difference deg. Fahr.
Bermudas	Cent.	15.1	24.0	8.9	
	Fahr.	59.2	75.2	" "	16.0
Bet. 31° & 32° N. Lat.		—	—	—	—
Natchez.	Cent.	10.0	25.4	15.4	
	Fahr.	50.0	77.7	" "	27.7

AGENDA MEETING.

Variation of Temperature

The effect of variation in Temperature on plants and animals.

Where the temperature is equible as on the Oceanic islands the vegitation is abundant but the varieties are few in numbers, & the qualities are inferior, producing only the lower animals the larger animals rarely inhabiting islands; and a slight variation of temperature produces a relaxation in the tissues of men, and they are usually docile and timid. In the interior of the continents where the changes are more abrupt on the contrary and the changes of vegitation is much larger, the varieties in species is far greater and it is superior in Characlas to the oceanic type while in quantity it is by far less.

The oceanic temperature produces uniformity the land temperature variety,

The land and water reach and act upon each other not only by the contact of the ocean to the land but also by the transportation of the sea water through the atmosphere as a medium, and the formation which consists of the moisture of the air condensed in such a way as to form a sort of vessels or sacks the shell of which consists of condensed water and the contents of atmospheric air which gives to them the low specific gravity which prevents them from falling. The rains are formed of drops of solid water the latter falling on the surface of the land forms streams and rivers, through the action of which the rugged parts of the Earth's surface are gradually converted into soil; the distribution of the rain depends to a great extent on the distribution of the winds.

WINDS

The winds are formed by currents in the air produced by the action of the suns heat; at the equator where the heat is most intense the current is nearly perpendicular, the lower strata being warm ascends and the cold following in from below to fill the partial vacuum produced; in order to demonstrate the truth of the above, we find that the barometer stationed at the equator show an average pressure equal to 75.8 millimeters while at lat. 45° the pressure is 76.1 millimeters, the air in that region is therefore heavier than that of the Equatorial zone. The overflow of expanded air at the Equator was direct north and South but the motion of the Earth imparts to the winds an oblique course, in the Southern Hemisphere it flows N.W. and in the Northern it flows S.W., in the tales

case N.E. and in the former S.E. The two motions from North to South meeting at the equator combine, the northern + South-ern motion is lost while that from East to west is lost retained, resulting in the pro-duction of the great trade winds, in the current of ascending air we find a region of Calms extending usually from 2° N. to 2° S. Lat: in this district, the air is liable to intrude either from the north or from the south so that in the regions of Calms we have most serious hurricanes. Over the oceans of the oceanic period the winds were reg-ular but with the appearance of the land above the sea, variations were produced partially by direct opposition of the land to the wind diverting it from its course as is the case with the Rocky mountains not the chief cause of interference is the

on rapid absorbtion of the heat by the dark portions of the land producing an upward current of greater intensity on the land than on the seas. On islands there prevails what is called land and sea breezes the later flowing in during the day, the former flowing out during the night to sea. This periodic change is due to the fact that during the day the land is hottest and the wind rushes in to supply the partial vacuum caused by the upward current, while at night the land cools and the atmosphere soon falls below the temperature of the sea air when the current moves in the opposite direction.

ELEVENTH LECTURE

TRADE WINDS

The trade winds of the Pacific do not follow Exactly the same line as those of the Atlantic: the N.E. trade of the Pacific Extends from 2° to 25° N. Lat reaching higher latitudes in the summer than in the winter; it takes its origin in the American Coast and Extends across the ocean to Australia, it was this wind that Carried Magalhaens across the ocean to Australia across the Pacific, and was for two hundred years the track of the Spanish treasure vessels from Acapulco to Manilla. The S. East Pacific Trade Extends from 2° to 21° South Lat. Extending farther South in the winter season. The region immediately upon the equator (2° N. to 2° S.) in the Pacific is the "region of Calms". In the Atlantic ocean the N.E. Trade blows between 8° & 28°

Lat. 2. In his first voyage Columbus fell into this current and it was the continuous character of the wind which was the cause of his dificulties with the crew, the sailors fearing that they would be unable to return against adverse winds. The S.E. Trade of the Atlantic always reaches North of the Equator and extends from 10° to 25° N. the Equator; the calms of the Atlantic lie between 3° and 8° N. of the Equator the position varies at different seasons; in August they extend from 3° to 13° N. in February from 1° to 6° N. Humboldt thinks that the Atlantic calms are higher than the Pacific, on account of the direction of the South American Coast and mountains which forces the thermal Equator N. of the true Equator. The region of calms is due to the fact that the ascending current of air naturally neutralizes the

horizontal current thus producing an equilibrium of force which is very uncertain and liable at any moment to hurricanes and tornadoes: The existence of the upper trade winds is demonstrated by the fact that in the eruption of volcanos situated in these regions the ashes are carried in different directions to the course of the lower trade winds: so in the Eruption of the volcano of Coseguina in Guatemala on the 25th of February 1835 the streets of Jamaca situated to the N. E. were covered with ashes. At the base of the Peak of Teneriffe the N.E. trade wind blows, while at the summit there is a continuous westerly wind the trades of the Atlantic and Pacific are influenced somewhat by the portion of mountains of Australia and

Central America.

Monsoons

These winds are found in and are almost peculiar to the Indian Ocean, they blow steadily for six months in one direction and the six months in the other; In this ocean the land prevents the N.E. trade wind from reaching it, so that the movements of the air upon the surface depends upon the manner in which the continents which surround it are heated; During our summer season the sun is north of the Equator and the portions of Asia, India & Persia are heated to a higher degree than Africa and Australia, Consequently there is a current of air Established, which as long as this Continues, moves steadily from the ocean

towards the North or Asia; during the remaining six months the sun is S. of the Equator. Consequently the lower portion of Africa and Australia are the hottest and therefore the course of the wind is altered and blows from N. to S. The periods of the Monsoons are as follows: from April to Oct, where the currents are changing; there is a continuous S. West. breeze, from N. E. from Oct. to April; where the currents are changing the winds are varying; in the So. China Sea the monsoons and trade winds meet and produce the most severe hurricanes that are known.

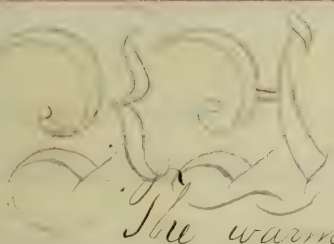
TWELFTH NIGHT

We have seen that the upper trade winds in the northern hemisphere, i. e. the Northern descend to the Earth and reaches it about 30° N. Lat., in Summer: the upper and lower winds thus meeting produce the variable winds; In the N. Atlantic the amount of westing in the variable winds is far greater than the amount of Easting; so that in making a voyage from Europe for America we have Easier accomplished than the return voyage - for the average of the 1st is from 20 to 23 days while the later requires from 35 to 40 days.

The greater portion of Land and mountains in the Northern Hemisphere, render the winds of that region more various; The influence of the mountain Chains is shown forcibly in the North American Continent in which

the Rocky Mountains confine the northern winds and since the Southern winds have no great mountain ranges to impede their course they are directed with almost unimpaired force from the Arctic Ocean to the Gulf of Mexico and Caribean Sea, in this region they meet the Edge of the N. Trade winds and tossing them in the flank produce the great circular Storms, which are so destructive to our Commerce along the American Coast.

Distribution of Rains



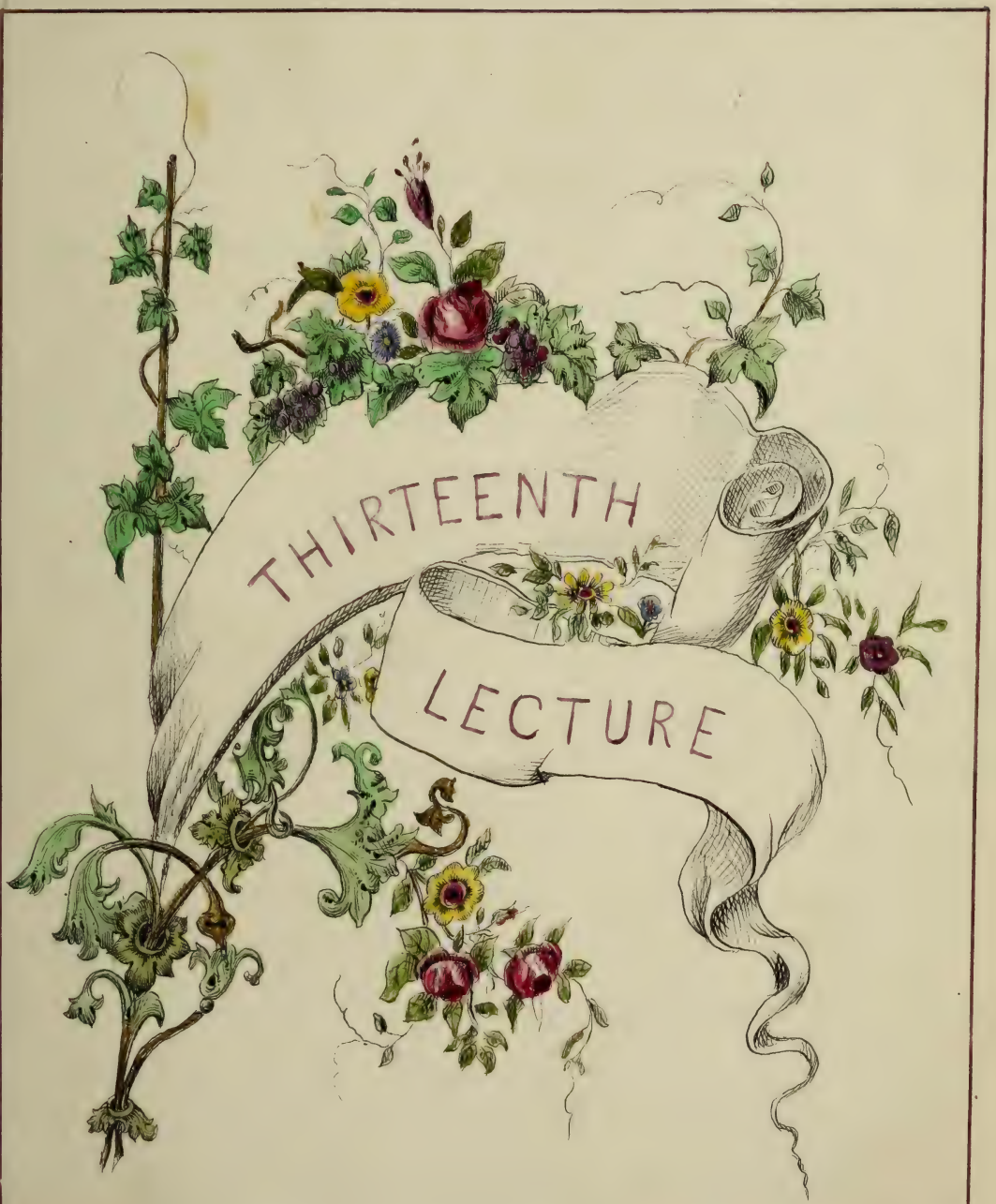
The warm air in contact with the land and sea is loaded with moisture produced by the action of the sun rays. as the layer of partial air rises into higher altetudes, the pressure on it being less and less. it increases in volume and Consequently since a given amount of heat is forced to diffuse itself to a greater space the column of air gradually becomes Cool, when the altitude becomes sufficiently great, the temperature of the air has decended so low that the moisture it Contains begins to Condense and form clouds, often after a cloud is formed it may come in contact with a stratum of warm air when the condensed moisture will again assume the vaporous form and the cloud disappears; when the temperature Continues to fall either by the cloud reaching a higher altitude or coming in contact with a stratum

of cold air the moisture increases in size and falls as rain. The amount of rain which fall in any given part depends to a considerable extent upon the direction of the prevaling winds, if it is from the sea it is loadid with moisture and the districk is fully supplied with rain: if on the contrary it is from the interior of the continent it is bare of moisture and there is but little rain.
On the coast of Africa winds from the Atlantic always bring rains, those from the desert of Sahara fair weather. Mountain ranges also influence rain to a considerable extent the supply of rain, for the range forces the wind that blows against it to rise higher and higher causing them to deposit the moisture they contain, so that after they reach the top of the range and decend on the

opposite side they are deprived of their moisture and one side of the mountain is fully supplied with moisture and verdure while the other is destitute of both. In the Tropical regions the winds and rains are both regular, the dry season continuing while the trade winds is blowing steadily and the wet season at the time when it changes. The greatest fall of rain is in the "region of calms" where the moist rainy air is forced to ascend to a considerable altitude before it forms the upper current. In the region of Monsoons the rainy season is when the wind is from the sea. In the Temperate regions the rain depends almost entirely on the course of the wind, relatively. The position of inland or ocean waters in the Tropical regions of the old world the average fall of rain is 77 inches per annum in the new it is 111 " " "

The greatest depth of rain in the world is at Mahabaleshwar in the western Ghauts South of Bombay, where the rain per annum falls to the depth of 302 in. The greatest depth in the New World is at St Louis de Maranhao, in Brazil, where the amount per annum is 276 in. demonstrating the cause of the rise of the Orenoco to the of Forty feet and also that of the Amazon. In the Temperate regions of the Old World the average fall of rain is 44 inches and in the New World 39 inches, as the winds gradually pass to the interior of the Continents they gradually lose their moisture and become dry. In the North of Europe between 40° & 45° the fall of rain in the British islands is 32 inches in 156 days Western France 25 inches 152 days Eastern France 22 in. 147 days Central and North Germany 20 in 150 " Hungary

111 days, 17 inches, Eastern Russia, Kasan 90 days 14 in
Western Russia Yarkoutsk 60 days 5 in. In our
own continent as we pass towards the Rocky Mts.
the fall of rain is less but its diminution not so
marked as in Europe-asia, for the winds of
the gulf, which are passing northwards in the
upper currents also carry moisture to the central
portion of the continent, so extending the area of
land available for cultivation. Of the continents
Europe is most open to the sea winds and
consequently is the only Continent without a
desert. South America is the most humid
of the continents the fall of rain being there
greater than any other, North America is
the best watered of the temperate regions.
Asia and Africa form the greatest contrasts
the Exceedingly dry and wet regions almost
touching Each other. This being in a great
measure due to the Table lands which
enter so largely into their formation


THIRTEENTH
LECTURE

Oceanic waters are subject to two varieties of move
ment, 1st tides & 2d currents. Tides are caused by the
attraction of the moon. That luminary as it passes a-
round the Earth attracts the waters of the sea raises them
above their natural level creating the great tidal wave
in some localities, as a channel between an island and
the main land, the channel grows narrower and narrower
the tidal wave is compressed, but since the waters are already
in motion and have attained a certain height & velocity they
cannot be stopped suddenly and so tides of Enormous heights
are produced. — Marine currents are due to the action of the
suns heat, and also by the action of the winds. The course
of the marine currents and the winds especially in the Equa-
torial regions being the same, the marine current which
possesses the greatest interest is the Gulf Stream. It originates
in the Indian ocean, thence it passes through the Chan-
nel of Mozambique to the cape of Good Hope, the greater por-
tion doubles the cape and passing in a N.W. direction
reaches Cape St Roque, there it divides the Southern

passing along the coast of S. America returning to Africa thro
the N. Atlantic Ocean, The N. branch leaving Cape St. Roque
passes along the north coast of S. America through the Caribean
Sea to the peninsula of Yucatan & then follows the coast thro
the Gulf of Mexico and passing out between Cuba & Florida flows
along the Atlantic coast of N. America to the Latitude of N.Y.,
thence it crosses the atlantic, a portion passing to the N. of
England and the remainder turning back touches the N. coast
of Africa & passes thence to the gulf of Mexico. The portion of the
atlantic in the interior of this circle is almost perfectly calm
consequently sea weeds & drift-wood accumulate to an enormous extent
in these regions forming the Sargossa Sea, In the Pacific the currents
move at the rate of 30 to 35 miles per day but in the Mozambique Chan-
nel is 5 miles per hour, the motion of the atlantic Gulf Stream is
from 2 to 5 miles per hour, being most rapid at points where the
Channel is most narrow along the N. American coast, The deep sea
current approaches the surface close to the coast while the true
Gulf Stream of N. York & Boston is at a distance of 300 miles
from the Coast, consequently in crossing the atlantic

vessels which leave N. York pass directly out to sea striking the Gulf Stream as quickly as possible and keeping in it. Enter the English Channel to reach South Hampton or of the Irish Channel passing Cork or the South Coast of Ireland to reach Liverpool. Leaving Liverpool on the return voyage they pass the N. Coast of Ireland when the weather permits cross the Gulf Stream as quickly as possible & Entering the Current from Hudsons Bay and Baffins Bay passes as close as possible to New Foundland hugging the Coast until they reach New York or Boston ——

FINIS.